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ABSTRACT

Means of aiding children when they are reading in a content field were suggested. The author pointed out that there are various structural or organizational patterns in different kinds of texts, and if students were made aware of these patterns they would have a way of preorganizing themselves to increase comprehension. The specialized content vocabulary and such text-accompanying materials as diagrams and charts were also mentioned as areas in which teachers should take special notice and concentrate instruction. Seven musts for teachers to keep in mind if they are going to diagnose and adjust to individual learning needs in reading science materials were offered. (NH)

TADPOLES MAKE THE NICEST FROGS

(Reading Science Selections)

by

Carl Bernard Smith

The title for this presentation comes from my son who has a strong penchant for bugs, toads and snakes. One time he brought home a pail of pond water in which there were some tadpoles. We watched the tadpoles develop through a number of stages, until sure enough, two of them survived as frogs. The day he got up and found that that's what happens, (and we had never really discussed what that whole process was all about) he commented, "Tadpoles make the nicest frogs."

That title does represent, I think, the kind of thinking a scientist engages in when he looks at nature and tries to come up with some conclusions about what he has observed. Perhaps that pattern of observing nature, of making some inferences about the observations, of classifying them, and of arriving at some conclusions or prediction, can give us some important clues as to how to read science content material.

Reading in any content field is different from reading in language arts or reading in a basal reader. This is not a surprising statement, but it needs to be repeated and repeated loudly, because teachers don't often teach children how to handle expository writing -- writing that is different from fiction, writing that is different from the short story style that students see in their basal reader.

There is a story in one of the basal readers that is called "A Kitty

for Kathy." It is a typical primary grade story with characters and a situation or problem that the characters try to resolve. After the students read the story, we ask: Who are the Characters? What are they trying to do? How do they do it? Did they succeed? We ask those questions because they indicate the organizational pattern of short story writing or of novel writing.

The story, "A Kitty for Kathy" is representative of that pattern. Kathy finds a kitty on the way home from the playground and asks her mother if she may keep it. Mother tells her that they can't keep the cat because they are going to grandmother's house for a week and they can't take the cat with them nor can they leave it home alone. Kathy asks if she can keep the cat provided she finds someone to take care of it while they are away. Mother consents to this plan. After a period of sitting on the door stoop, Kathy gets a bright idea. She goes next door and asks Mrs. Henrietta if she will babysit for her. Mrs. Henrietta says that she will be happy to babysit for Kathy anytime. Then Kathy explains that it is a cat she is to sit with. Mrs. Henrietta, being a nice neighbor, accepts the kittysitting job for the week and the problem is solved. That is typical of the basal reader story which we have children analyze for three, four, five and six years.

But the child has to read other types of material in expository writing. Are there characters, a plot, a problem to be solved, or some interaction between characters? Probably not. So what does the child do? What kind of questions does he ask when he approaches the material and tries to comprehend it. The chances are, unless he has an exceptional teacher, he will not be told how to comprehend the content material. The teacher will tell him

that the class will diacuss the topic; that he is to read the next several pages. The queations asked probably will be something like: What is a tadpole? Where do tadpoles live? How do tadpoles develop? The child must consider many facts and detaila, but seldom does the teacher tell the child that there are waya to analyze content material so that the author's purpose and thinking can be identified.

Through a series of analyses I have made in science, social studies, and mathematics texts, I have found that there are structural patterns, or organizational patterns in different kinds of texta. If we alerted students to these patterns they would have a way of pre-organizing themselvea to increase comprehension.

Comprehension in any material usually meana more than recalling a number of facts. A reader must have the main idea, know the important details, and see the interrelationship of the parts. To analyze scientific data, classify it, and find some conclusion or resulting law, a reader must begin with literal comprehension. Beyond that he has to know what the various parts of the selection are, what relationships exist among the parts and how those relationshipa lead to some conclusion. That kind of comprehension process is seldom taught in our schools.

There are also study skills related to reading in the content areas. It is of prime importance that we teach children locational skills and rate adjustment skills to help them read expository writing.

Levels of Difficulty in Science Texts

Consider for a moment, the problems a child faces when he comes to the task of reading science content. In one textbook there is a selection which discusses how Mendle first discovered the facts about heredity.

According to the publisher the article was written for junior and senior high school students. The teacher's guide states that it is written for the lower track of the junior and senior high school groups, but no specific grade or readability level is given. Evidently it is meant to be read at some level below grade seven. According to the Dale Chall readability formula the reading level is 7.8.* Thus it would appear that some of the people for whom the book is intended will have difficulty with it.

A second selection taken from an elementary school science text is designed for grade five according to the publisher. In the teacher's guide the authors say they were deliberately conscious of writing on a simple level so it can be used by children whose reading skills are average or below. Using the Dale Chall readability formula on this grade five text produces a grade readability of 9.1.

Why should the material rate much more difficult than the publisher and the authors estimate? One reason is the number of difficult words, or words which do not appear on the list of words called easy words in the readability formula. The larger the number of difficult words, the higher the readability level will be. The list of easy words is composed of words that appear most frequently in basal readers. Therefore, we are training the children to read easy words but asking them to read, heredity, Austrian, Monk, monastary, differed, traits, cross-pollinated, resulting, off-spring. All of those words appear in one paragraph of the secondary text and are considered difficult words because they are not commonly used. In the next paragraph we find, generation, pure-bred, produced, tallness, dominant, shortness, recessive,

*Readability formulae, include the number of difficult words and the length of the sentence combined with a mathematical formula to produce the grade equivalent of the material.

expressed. One out of every eight words in this article is not regularly used in basal readers or language arts texts, and therefore, children do not respond to them automatically. They have to stop and analyze them if they have sufficient word analysis skills. What does hybrid mean? I can analyze all day and I'm not going to know what hybrid means unless I'm from the farm belt. Even then I may not know, but know only that hybrid is a word used for corn. I have to have some way to relate these words to my experience and some way of recognizing them, of identifying them.

Systematically block out every eighth word in the article on Mendle and see how easy it is to read the passage and to understand it. By systematically deleting words, form words like a, the, in and out are likewise eliminated, yet they are quite simple to figure out. But block out monastary, hybrid, cross-pollination, and pure-bred as the child does and see what happens to comprehension.

The fifth grade text rated 9.1 on the Dale-Chall Formula presents still further difficulty. The first line contains, esophagus, stomach lining, soften, chemicals and particles: all words not found in the easy word list. In the same paragraph, completely, digested, moist, valve, coiled, tubes, liver, pancreas, intestine, glands, molecules, bloodstream, capillaries, gristle, stringy fibers are all words not on the easy list. One out of six of these words is not in the easy word list. Try blocking out every sixth word in a passage and see what that does to your comprehension. Words that are essential to comprehension cannot be identified by the reader. It is evident, therefore, that vocabulary plays a key role in any kind of reading in the content area.

Teachers need to know ways to teach vocabulary and how to treat content

vocabulary as a reading teacher would. They have to build background so the child has the concepts to work with. They have to present vocabulary in terms of concept development as well as in terms of word recognition.

One of the problems with science vocabulary is that it changes so rapidly; so many new words keep coming into the science field that it is difficult to keep them in the dictionary. For example, in the 1955 edition of the Oxford Universal Dictionary, these terms were not listed: astronaut, blast-off, count-down, cosmonaut. Check your dictionaries at school and see when they were published. When I was teaching high school in the early sixties, every student in school had a dictionary. That was a school policy. But 90 per cent of the dictionaries were published in the 1930's. One way to help solve this time lag problem is by teaching some Latin and Greek roots, enabling students to identify them and to know what they mean. There is, for example, a great variety of words using the root astro- meaning stars or heavenly bodies. Add the root naut meaning ships and navigation, and the student can solve astronaut with a minimum of difficulty. Further, the knowledge will transfer to other sets of words using those roots.

In addition to vocabulary problems in science material, there are diagrams, charts and tables that accompany the text, and usually it is rather essential to relate the text to the diagrams.

Here is a story entitled "From Tadpoles to Frogs" taken from a second grade book:

> When I first put my tadpoles into the bowl they were funny little things. I had never seen anything like them before. They stayed under water all the time.

If I were a student from the city, I might not know what a tadpole is.

For Hoosiers who can find tadpoles in ponds and creeks this is no problem. Think of the kids in Cleveland and New York City. They don't know what a tadpole is. They may never have seen a live pig.

When I went to college I met people from all kinds of places. One of the boys was from Brooklyn, New York. On the train from Brooklyn to the mid-west, he saw his first live pig, his first live cow. This young man was 19 years old. It is not unrealistic to say, therefore, that many second grade children do not know what a tadpole is.

Teachers have to build a concept here and relate the text to the illustration. The science text gives a diagram, a picture or an illustration. A child reads: "I'd never seen anything like them before. They stayed under water all the time." Can't you imagine, without illustrations, just what the reader is thinking? What has he seen on television that stays underwater and he has never seen anything like it before?

The illustrations explain what happens in the growth of a tadpole. The teacher has to explain -- "Look at the pictures and go back to the text." This seems quite elementary, but for the child who doesn't have the experience, the teacher has to explain how to relate illustrations to the text.

The tadpole story was a grade two science reading problem. What does a grade four science text talk about? A refracting telescope. Now the problem is more difficult, for not only does the student not understand what a refracting telescope is, but the teacher too must study diligently at night to relate the text to a diagram. Relating the drawing to text is a reading skill. It is a skill that is necessary to read the science text intelligently. Start moving systematically through the diagram to find out where

the texts explanation and the diagram correspond. It is important to remind the children that reading the illustrations will help them visualize, conceptualize, and understand.

Relating the text material to the illustrations is just one factor. The primary goal is to teach the child to comprehend the totality of what he is reading. He is supposed to comprehend what the scientist had in mind when he made an observation of nature and when he wrote about what he saw or learned. The reader has to know how the scientist thinks when he writes.

How does a scientist think? He observes; he classifies, he concludes and he predicts. This is a very typical pattern for a science presentation, whether in primary grade science books or college texts. There are other patterns for writing science material, but knowing this one will help the child understand the structure of the majority of science selections. At least he has one handle to hang on to when he tries to analyze and comprehend. He can read with the anticipation that first the article will give a focus and list a number of details about the topic. Second, the details will be organized or classified according to some identified system; and finally, a conclusion or a prediction about the observations, the topic, will be given.

Conclusion

Comprehension is a broad topic that involves background concepts, vocabulary analysis, inferential thinking and evaluation. The reader must synthesize what he reads into some sort of total picture, and relate it to his life.

If teachers are going to diagnose, and adjust to individual learning needs in reading science, there are a number of things they will have to do.

1) They must prepare the student to identify special vocabulary.

2) They must prepare the student for the meanings of specialized vocabulary.

3) They must prepare the student for new and important concepts.

4) Teachers must show the student how to use the typography peculiar to the book, selection, or material. The marginal headings, diagrams, charts, and italicized words are important aids to learning.

5) Teachers must demonstrate to the student the structure of the discipline.

6) They must guide the student in the analysis of the selection by showing him what relevant criteria to apply.

7) Teachers must also evaluate the student at various points including: his recall of words and concepts, his assimilation of basic meanings and his analysis of relationships.

Teachers must find out whether the student can tell how things are related, or if he can apply criteria for evaluating what he has read. Does he know what is relevant? Can he distinguish between fact and opinion? The final criterion on which to evaluate the student then is the question: Can he apply the knowledge that he has gleaned from the expository content.

That is what it takes if we are going to teach reading in science, or in any other content subject.

Content Reading Bibliographies

There are several bibliographies on reading in content subjects which can be obtained from the Reading Program of Indiana University. Write for information concerning these bibliographies:

1. Roelke, Patricia, "Critical Reading and Content Reading," Occasional Papers in Reading, Vol. 2, No. 2, Indiana University--Bloomington, 1968.
2. Harris, Larry, "Research on Reading in the Content Fields: Language Arts," ERIC/CRIER Reading Review Series, Vol. 2, No. 9, Indiana University--Bloomington, 1968.
3. Laffey, James. "Research on Reading in the Content Fields: Mathematics, Science, and Social Studies," ERIC/CRIER Reading Review Series, Vol. 2, No. 10, Indiana University--Bloomington, 1968.